OBSERVATIONS ON THE TEMPERATE AFFINITIES OF THE VEGETATION OF HANGKLIP MOUNTAIN NEAR QUEENSTOWN, C.P.

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Abstract

The vegetation of Hangklip mountain (6848′) is described on the basis of the main communities delineated on the physiognomy and affinities of the dominants concerned. The floristic composition of nine communities is described, the following communities being recognized: Mixed Thornveld of the plains, Mixed Ravine Bush of the lower xerocline, *Elyonurus* grassveld of the mid-altitude plateaux, *Leucosidea* Open Woodland of the southern slopes, *Bromus-Chrysocoma* association of the upper southern slopes, *Festuca scabra* consociation of the upper mesocline, *Buddleia* forest of the high altitude ravines, Rock Scree communities and *Harpechloa-Danthonia-Pentaschistis* grassveld of the summit plateau.

The temperate affinities of the communities are discussed in relation to altitude and aspect influences. The significance of the temperate flora is explained in the light of the relevant literature.

INTRODUCTION

Hangklip mountain is a striking landmark several miles north of Queenstown in the eastern Cape Province, situated at latitude 31° 53′ S and longtitude 26° 53′ E. The mountain rises to a height of 6848 feet above sea level and is constituted for the most part of sedimentary geological formations of the Beaufort Series, with the exception of the perpendicular-sided summit formed by a massive dolerite buttress which dominates the scenery for many miles around (Plates 1—3).

The climate of the area is characterized by an erratic summer rainfall which averages 21″ (533 mm.) per annum, of which only 7% falls during the months of June, July and August. Temperatures for the period 1873–1950 as measured at Queenstown are given in Table 1.

Table 1

Average monthly temperatures for Queenstown 1873—1950 *in degrees centigrade*

J	F	M	A	M	J	J	A	S	O	N	D	Mean
22·1	21·9	20·5	17·1	13·6	10·7	10·3	12·6	15·3	17·5	19·1	21·3	16·9

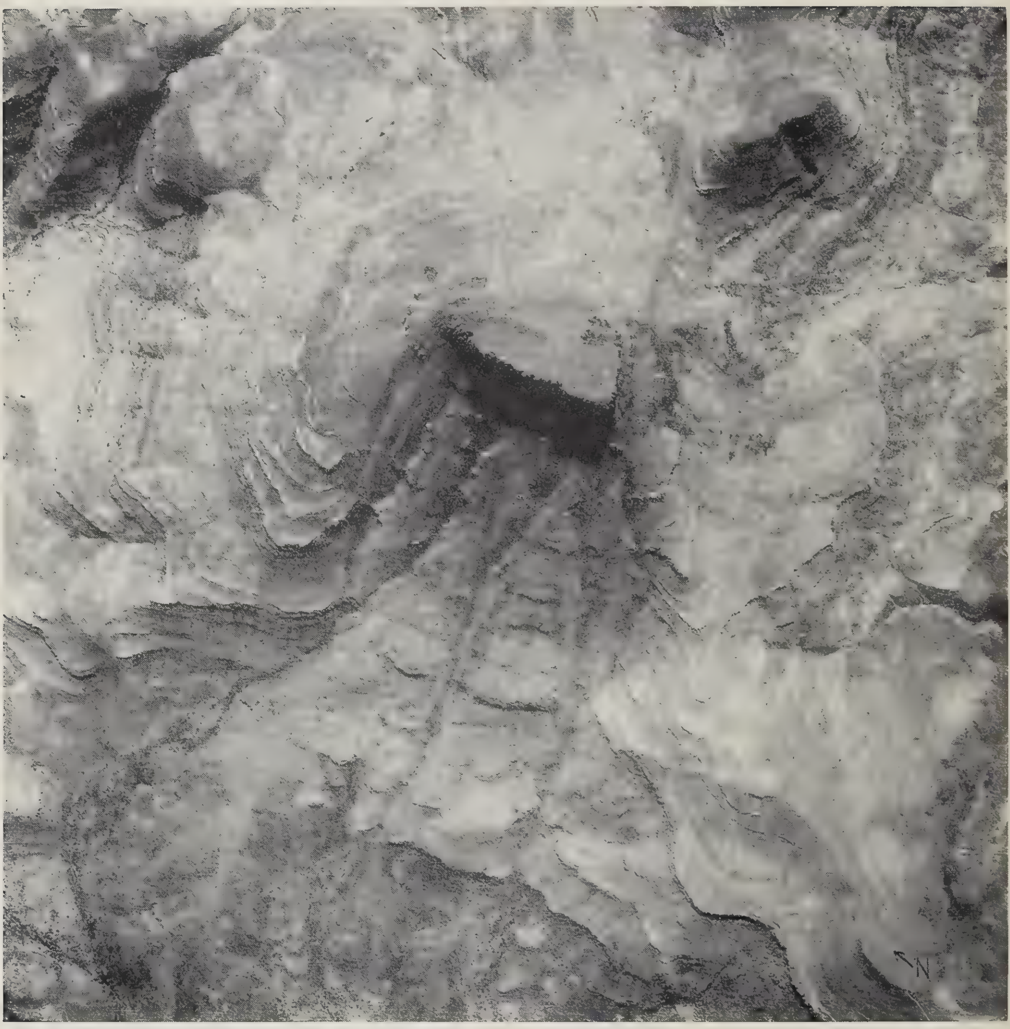

Plate 1
Aerial photograph of Hangklip Mountain (1;10,000).
Photo: Director, Trigsurvey, Pretoria

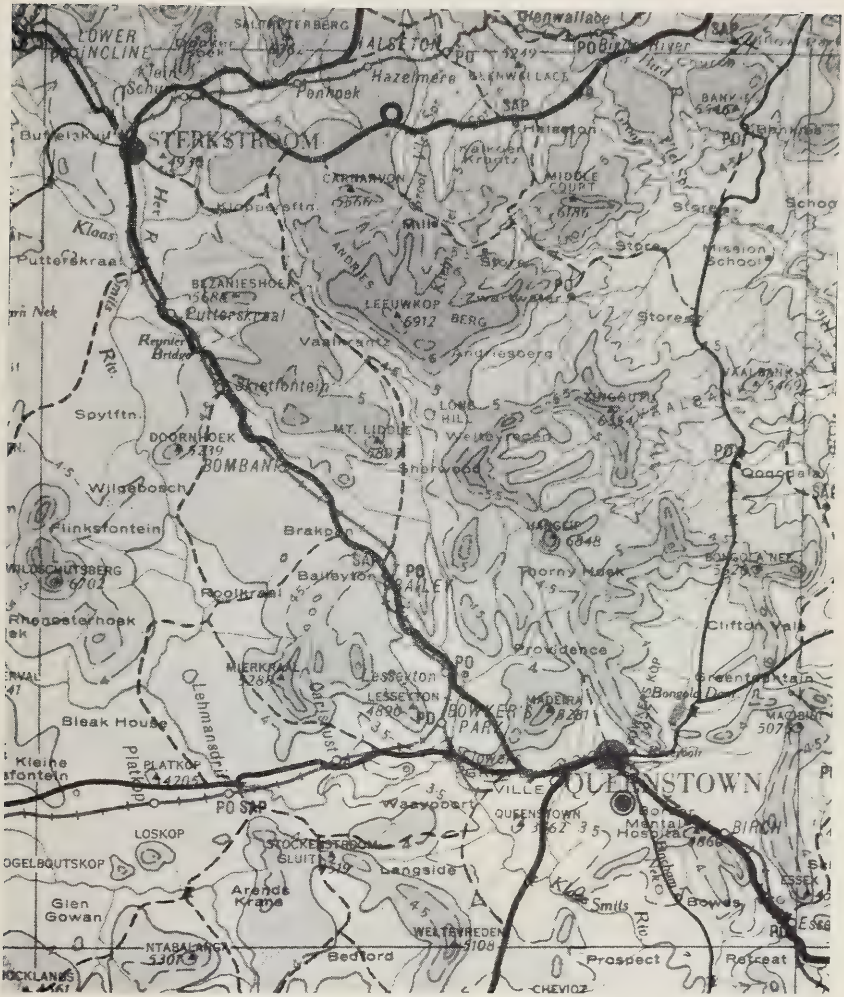

PLATE 2
Map of Queenstown and Environs

The average lowest minimum and highest maximum temperatures recorded over the above-mentioned period are –3·9°C (July) and 38·0°C (January).

The surrounding country, which lies between 3500′ and 4000′ consists of gently undulating grassveld, with varying degrees of *Acacia* thicket formation occurring in the lower-lying regions. The vegetation of the plains in this area is made up almost entirely of species belonging to the subtropical element of the South African flora and of particular interest to the ecologist is the manner in which genera of the temperate element become more important with increase in altitude on Hangklip mountain. This change in both physiognomy and floristic composition can only be ascribed to micro-climatic changes with altitude since geological formations and edaphic features on the upper portion of the mountain closely resemble those at lower altitudes where the normal sweetveld savannah occurs.

Plate 3
Hangklip from the south

The Vegetation

The vegetation has been classified into nine main communities on the basis of physiognomic dominants and affinities of the vegetation. Since this study is aimed only at recording the presence and importance of species with subtropical and temperate affinities, no consideration is given to quantitative measures. The communities recognised are:

1. Mixed Thornveld of the plains.
2. Mixed Ravine Bush of the lower xerocline.
3. *Elyonurus* grassveld of the mid-altitude plateaux.
4. *Leucosidea* Open Woodland of the southern slopes.
5. *Bromus-Chrysocoma* association of the upper southern slope.
6. *Festuca scabra* consociation of the upper mesocline.
7. *Buddleia* forest of the high altitude ravines.
8. Rock Scree communities.
9. *Harpechloa-Danthonia-Pentaschistis* grassveld of the summit plateau.

Specimens of all the plants listed in this paper are preserved in the herbarium of the Department of Pasture Science, University of the Orange Free State, Bloemfontein and a duplicate set has been sent to the National Herbarium, Pretoria. Numbers are the writers' collectors' numbers.

1. *Mixed Thornveld community of the plains* (Plate 4)

The *Acacia* savannah of the plains varies greatly in botanical composition and at the base of the mountain on the northern side the following species are the most important:

Acacia karoo Hayne.
Euclea crispa var. crispa (Thunb.) Guerke var. crispa de Winter.
Scolopia mundii (E. & Z.) Warb.
Diospyros whyteana (Hiern) F. White.
Trimeria trinervis Harv.
Clematis brachiata Thunb.
Asparagus iocladus (sp. compact).
Maytenus cymosus.
Melolobium calycinum Benth.
Aster filifolius Vent.
Aster muricatus Less.
Chrysocoma tenuifolia Berg.
The grass cover is made up largely of sweetveld species and includes:
Themeda triandra Forsk.
Elyonurus argenteus Nees.
Heteropogon contortus (L.) Beauv.
Cymbopogon plurinodis. Stapf ex Burtt Davy.
Melica racemosa Thunb.
Eragrostis curvula (Schrad.) Nees.
E. lehmanniana Nees.
E. obtusa Munro ex Fic. et Hiern.
E. chloramelas Steud.
Aristida congesta Roem. et Schult.
A. curvata Nees Trin. et Rupr.
Sporobolus fimbriatus Nees.

Overgrazing has resulted in severe erosion in this low-lying area. The purple shale formation on which this community occurs is particularly susceptible to surface erosion and wherever this shale occurs on a slope and denudation of the grass sward takes place, sheet- and later gulley-erosion soon follow. Injudicious chopping of thornbush, presumably for firewood, has led to replacement of the original open *Acacia* savannah by a dense thornbush thicket in some areas.

2. *Mixed Ravine Bush of the lower xerocline*

The vegetation on the xerocline follows the pattern so often found on mountains in the semi-arid areas of South Africa, namely dominantly grassveld except in ravines and rocky areas where woody plants tend to dominate, largely as a result of the improved moisture conditions and protection in such habitats. In the case of Hangklip, the xerocline ravine bush community is a mixture of the shrubs of the plains and the more mesophytic trees typical of the upper mesocline forest. Thus in addition to the woody plants listed above under the Thornveld community of the plains, the following woody species are also common constituents of the mixed ravine bush of the xerocline:

Halleria lucida L.
Cussonia paniculata E. & Z.
Rhus glauca Desf.
Rhus erosa Thunb.
Grewia occidentalis L.
Myrsine africana L.
Olea africana Mill.
Scolopia zeyheri (Nees) Harv.
Pavetta capensis (Houtt.) Brem.
Clutea pulchella L.
Rhamnus prinoides L. Herit.
Encephalartos cycadifolius Lehm.

Typical of warm dry rocky sites such as occur along the margins of the xerocline ravine bush is the grass *Setaria lindenbergiana* (Nees) Stapf which, according to the writer's observations in neighbouring districts (Roberts, 1963) is largely limited to such habitats in this region.

PLATE 4
Mixed bush on lower N. slope of Hangklip

PLATE 5
Elyonurus grassland on N. slope

3. **Elyonurus** *grassveld of the mid-altitude plateaux* (Plate 5)

The geological structure of the mountain, being constituted of strata of sedimentary rocks, has given rise to a number of mountainside plateaux of varying size on the northern and eastern aspects. These plateaux display a mixed grassveld, dominated by the "sour" species *Elyonurus argenteus* Nees which is clearly actively increasing as a result of selective grazing. This grassveld occurs between 5000′ and 6000′ immediately above the zone at which *Acacia karoo* and *Olea africana* disappear. The grass cover of this community contains all the species listed in the *Acacia* thornveld together with a high proportion of sourveld species such as *Eragrostis capensis* (Thunb.) Trin., *E. racemosa* (Thunb.) Steud. and *Tristachya hispida* (L. f.) K. Schum.

4. **Leucosidea** *Open Woodland of the southern slopes*

This is an open woodland consisting mainly of *Leucosidea sericea* E. & Z. trees in a short mixed grassveld and occurs on stoneless slopes adjacent to the

Festuca scabra grassveld at high altitudes on the southern slopes. Indications are that, in the absence of boulders, fire has eliminated all tree species, with the exception of *Leucosidea* which has been observed by the writer to form pure consocies in mountain sourveld which is subjected to periodic fires in many high rainfall areas, e.g. Basutoland, Golden Gate, Witsieshoek, Thaba 'Nchu, Zastron and Giants' Castle. Ecologically this woodland may be considered as being below the *Buddleia* forest in the succession, owing to the latter's mixed dominance, closed canopy and variety of species in a number of strata.

5. **Bromus-Chrysocoma** *Association of the upper southern slopes*

The upper southern slopes situated immediately below the main precipice, experience unique environmental conditions as compared with other habitats in the locality. The *Bromus-Chrysocoma* association described below occurs on a steep southern slope of sandy soil which is virtually black as a result of the marked accumulation of organic matter. This habitat receives a reduced amount of direct sunlight which strikes the soil surface at an oblique angle during the summer and no direct sunlight at all during the winter. Theoretically the physiographic features which make up this habitat (altitude, aspect, slope and the proximity the massive precipice above) should combine to produce the coolest and most moist habitat in the area under investigation. The influence of these microclimatic factors is directly reflected in the floristic composition of the community which occurs here. Scarcely a single grass species of tropical affinity is found in this community, while the following species are typical:

Bromus leptocladus Nees.
Danthonia purpurea (Thunb.) Beauv.
Danthonia districha Nees.
Danthonia stricta (Nees) Schrad.
Danthonia macowanii Stapf.
Lasiochloa longifolia (Schad.) Kunth.
Festuca scabra Vahl.
Festuca caprina Nees.
Ehrharta calycina Sm.
Ehrharta erecta Lam.
Pentaschistis setifolia (Thunb.) McClean.
Pentaschistis sp. (Roberts, 2038).
Helictotrichon longifolium (Nees) Schweickerdt.
Trachypogon spicatus (L. f.) O. Ktze.
Koeleria cristata (L.) Pers.
Cymbopogon proxilus (Stapf.) Phillips

All the woody plants which are associated with the above temperate grasses in this cool mesophytic habitat are of the sclerophyllous type and most of them may be regarded as relics of an earlier macchia vegetation, namely:

Cliffortia paucistaminea H. Weim.
Anthospermum tricostatum Sond.
Thesium imbricatum Thunb.
Passerina montana Thod.
Passerina sp. (Roberts 2001).
Erica schlecteri Bol.
Elytropappus rhinocerotis Less.
Relhania pungens L'Herit.

Together with these sclerophyllous bushes, *Chrysocoma tenuifolia* Berg. occurs very frequently, forming large consociations within this mixed temperate community. The abundance of *Chrysocoma* in this habitat is of particular ecological interest in view of the encroachment and domination of this bush over large areas of the eastern karoo and southern Orange Free State, where it appears equally well adapted to hot, dry plains.

Herbs of general occurrence in this community include:

Senecio juniperus L.
Senecio isatideus DC.
Senecio hieracioides DC.
Helichrysum capillaceum Less.
Helichrysum chionosphaerum DC.
Helichrysum trilineatum DC.
Helichrysum dregeanum Harv. & Sond.
Helichrysum subglomeratum Less.
Helichrysum miconeaefolium DC.
Myosotis sylvatica Hoffm.
Delosperma sp. (Roberts 2132).
Osteospermum caulescens Harv.
Scabiosa columbaria L.
Sutera ? floribunda (Roberts 2029).
Chaetacanthus setiger (Pers) Lindau.
Berkheya purpurea (DC.) Mast.
Melolobium microphyllum E. & Z.
Ornithogalum leptophyllum Bak.
Trachyandra saltii (Bak.) Oberm.
Gladiolus permeabilis de la Roche.

A striking feature of the ground layer of this community is the great abundance of the prostrate clover *Trifolium burchellianum* Ser. which covers and binds the sloping sandy soil by forming extensive dense mats on the soil surface.

PLATE 6
Festuca Grassland on upper southern aspect

6. **Festuca scabra** *consociation of the upper mesocline* (Plate 6)

Those portions of the upper southern slopes which are devoid of boulders are completely dominated and covered by a dense uniform growth of virtually pure *Festuca scabra* Vahl. This grass is characteristic of cool high altitude sourveld in the nearby Amatole mountains, but nowhere has the writer encountered such a homogeneous mass of huge tufts of this grass as occurs on Hangklip. No explanation can be given for the exclusion of virtually all other species from this community. A closely related species, namely *Festuca costata* Nees occurs abundantly in the mountains of the nearby region known as the Bontebok Flats.

7. **Buddleia** *forest of the high altitude ravines* (Plate 7)

Four roughly parallel ravines run from below the imposing summit precipice to the foot on the south western aspect of the mountain. Beside the marked change in the species of woody plants with altitude within the ravines, soil conditions, varying from sandy to clayey doleritic soil and from deep soil to typical scree conditions with massive boulders, are associated with a marked variation in structure and floristic composition of the forest. The general pattern is a gradual change from bush dominated by *Acacia karoo* to a mixed ravine bush, at about 5000′, which is similar in composition and structure to the mixed bush of the xerocline ravines. This mixed bush then gives way to a more mesophytic bush between 6000′ and 6500′ and since *Buddleia salvifolia* Lam. is the dominant in large areas of the upper reaches of these ravines, the name *Buddleia* forest has been given to this advanced community. The following trees and shrubs are typical of this community:

Buddleia salvifolia Lam.
Kiggelaria africana L.
Clutea pulchella L.
Heteromorpha trifoliata (Wendl.)
Rhamnus prinoides L'Herit.
Halleria lucida L.
Rhus divaricata E. & Z.
Rhus glauca Desf.
Rhus dentata Thunb.
Euclea crispa var. crispa (Thunb.) Guerke.
Euclea coriacea A. DC.
Polemannia grossulariaefolia E. & Z.

Mention should here be made of the lichen *Usnea* locally known as "Spanish Moss" or "Old Man's Beard", which grows on the larger trees of this mesophytic forest. The presence of this lichen in such abundance gives some indication of the amount of atmospheric moisture prevailing on the southern slopes at higher altitudes.

The understory of this forest requires further investigation but contains amongst others the following species:

Asparagus microraphis Kunth.
Asparagus asparagoides (L.) Wight.
Clematis brachiata Thunb.
Geranium ornithopodum E. & Z.
Geranium harveyi Brig.
Linum thunbergii E. & Z.
Valeriana capensis Thunb.
Galium capense Thunb.
Galium rotundifolium L.
Anchusa capensis Thunb.
Silene burchellii Otth.
Silene capensis Otth.
Pelargonium leucophyllum Turcz.
Pelargonium sp. (Roberts 2091).
Nemesia capensis (Thunb.) Ktze.
Polygala serpentaria E. & Z.
Blechnum australe L.
Diascia stachyoides Schltr.
Melica decumbens Thunb.
Poa binnata Nees.
Ehrharta erecta Lam.
Cheilanthes multifida.
Woodsia burgessiana Genr.
Pellea quadripinnata (Forsk.) Prantl.
Polystichum lucidum (Burn.) Bech.

PLATE 7
Buddleia forest

Though limited in distribution and area, this closed forest must be regarded as the most well developed community within the area under investigation. The degree to which this community represents a climatic climax, is debatable, since although a *Podocarpus* climax is to be found in certain areas of the Amatole mountains in this district, the low temperature associated with altitudes above 6000′ may well preclude *Podocarpus* here as it apparently does on the nearby Hogsback range.

8. *Rock Scree Communities*

Difficulties arise in the delineation of the scree communities, however the following three groups have been recognized:

(*a*) **Aloe-Kiggelaria** *association of the upper northern screes.*

The rugged screes of huge lichen-clad dolerite boulders near the summit on the northern aspect provide a suitable habitat for those species requiring complete protection during the seedling stage, especially from fire. The two most important species growing in the deep crevices of these screes are *Aloe tenuior*? and *Kiggelaria africana* L. Constituents of this community in screes composed of smaller rocks, include most of the plants mentioned under the summit habitats. The wind-pruned appearance of both the aloes and the *Kiggelaria* trees indicates that high wind velocities play an important part in the determining the physiognomy of the vegetation in these sites.

(*b*) **Euryops** *consociation*

Amongst the fallen rocks on the talus slopes immediately below the eastern precipice of the summit buttress, the sclerophyllous shrub *Euryops brevipappus* M. D. Henderson ("Harpuisbos" or Paraffinbush) dominates the scree vegetation, forming large areas of bright-yellow flowered bush. Several other species of *Euryops* which are associated with incorrect veld management in the surrounding districts are encroaching on certain mountainous farms. *Euryops brevipappus* forms a dense almost inpenetrable thicket with the result that the ground layer of the vegetation is virtually absent beneath its canopy.

(*c*) **Relhania-Helichrysum** *association*

Of the various temperate communities on Hangklip mountain, the *Relhania pungens* L'Herit-*Helichrysum triclineatum* DC association is, from a physiognomic point of view, the most strikingly typical of the temperate flora. Even to the untrained eye this sclerophyllous scrub must appear foreign in an area with predominantly subtropical affinities in its vegetation. This scrub is very limited in size and distribution, the largest patch of it occurring in the upper north-western scree adjoining the summit plateau. Beside the two dominants mentioned above, other macchia representatives such as *Elytropappus rhinocerotis* and *Passerina montana* are constituents of this community.

9. **Harpechloa-Danthonia-Pentaschistis** *grassveld of the Summit Plateau* (Plate 8)

The summit plateau vegetation consists of a short dense grassveld, virtually devoid of all trees and shrubs. The soil is shallow and of doleritic origin. Soil depth varies according to local variations in slope and these variations have led to accompanying variations in plant cover. The occurrence of boulders is also associated with an invariable change in vegetation, presumably as a result of the protection which such stony habitats provide against the influences of wind and fire, which alone or in combination, are generally associated with the grassland formation.

Of the plants which constitute the exposed summit grassveld the following species are the most abundant:

Harpechloa falx (L.) O. Ktze.
Trachypogon spicatus (L. f.) O. Ktze.
Pentaschistis setifolia (Thunb.) McClean.
Pentaschistis sp. (Roberts 2038).
Koeleria cristata (L.) Pers.
Ehrharta calycina Sm.
Andropogon appendiculatus Nees.
Aristida junciformis ssp. galpinii Trin. et Rupr.
Danthonia purpurea (Thunb.) Beauv.
D. macowanii Stapf.
Microchloa caffra Nees.
Festuca caprina Nees.
Tristachya hispida (L. f.) K. Schum.
Eragrostis chloramelas Steud.
E. racemosa (Thunb.) Steud.
E. capensis (Thunb.) Trin.

Of the non-grasses only a limited number of stunted bushes and seasonal aspect *Monocotoledonae* occur to any marked extent under these exposed conditions, namely:

Helichrysum fulgidum Willd.
Cliffortia paucistaninea H. Weim.
Aster muricatus Less.
Eriospermum sp. (Roberts 2061).
Selago brevifolia Rolfe.
Clutea laxa Eckl.
Senecio asperulus D.C.
Cyrtanthus o'brienii Bak.
Bulbine abyssinica A. Rich.

Where large blocks of dolerite afford a more favourable habit, particularly situations sheltered from high winds, an unusual assortment of species is found, having affinities with many different communities, namely:

Euryops brevipappus M.D. Henderson.
Rhoicissus microphylla (Turcz.) Gilg & Brandt.
Kiggelaria africana L.
Clutea pulchella L.
Galium rotundifolium L.
Anachusa capensis Thunb.
Berkheya buphthalmoides (D.C.) Schltr.
Silene burchellii Otth.
Geranium ornithopodum E. & Z.
Schoenoxiphium sp. (Roberts 2057).
Cheilanthes sp. (Roberts 2058).
The exceptionally rare fern Woodsia burgessiana (Roberts 2055) also occurs in this mixed community.

The significance of the temperate vegetation of Hangklip

From a phytogeographic point of view the importance of the occurrence of

Plate 8
Hangklip summit looking North

elements of temperate vegetation on Hangklip mountain is out of proportion to the size of these communities and their contribution to the vegetation as a whole. Since the theories surrounding the origin, migration and adaptation of the temperate ("Fynbos", Macchia or Cape) flora has a direct bearing on the understanding of the dynamic aspects of the other vegetation types present, the significance of the representatives of the temperate flora may be discussed in some detail.

The term "sclerophyllous bush" was originally employed by Schimper (1903) in describing the bush of winter rainfall areas of the world, including the south-western Cape. Warming (1909) used the word "maqui", for the Cape flora and at the present time the term "macchia" and its generally accepted Afrikaans equivalent "fynbos" are commonly used. All these terms refer to a community of evergreen shrubs with small ericoid or linear rolled leaves. The term "macchia" used in this text refers to growth form and not to any specific floristic composition.

A number of writers have discussed the origin of South African vegetation (Levyns, 1938; Marloth, 1929; Bews, 1925; Schonland, 1907 and 1909; Sim, 1920 and Bredenkamp, 1935) and it is generally agreed that macchia had a much wider distribution than is the case to-day (Rennie, 1935). In Acocks' (1953) words, "It was pushed back by the sward-forming tropical grasses, when they appeared, into its strongholds in the winter-rainfall areas and areas on mountain ranges and along coastlines where winter moisture is available and conditions are less suited to the tropical grasses. The picture is obscured by the surging backwards and forwards of vegetation types in response to less ancient changes of climate which we know to have more than once occurred. The relicts of Fynbos in tropical vegetation, therefore, may have more than one origin, though the presence of *Erica* in Europe and of *Podocarpus* and *Protea* in Central Africa is likely to be an indicator of the ancient distribution of Fynbos. It must here be pointed out that these climatic changes probably occurred over periods of tens of thousands, or hundreds of thousands of years, and not over periods of a century or less, like the changes in vegetation we are witnessing to-day".

The thickening up and movement of several species of the macchia vegetation in numerous parts of the summer-rainfall area indicate that the macchia migrations are still very active. Acocks (1953) regards the tall form of karoo vegetation which has invaded the inland mountains (Karroid *Danthonia* Mountain Veld and *Themeda-Festuca* Alpine Veld) as being so closely related to the macchia as to warrant its being regarded as macchia invasion. This movement includes *Cliffortia*, *Passerina* and *Pentzia cooperi*. In the same way the Drakensberg is considered to be an important migration route from the south for temperate species such as *Passerina montana*. This is paralleled by the spread of *Elytropappus*, *Euryops* and *Aster* in the south eastern Cape coastal regions from Humansdorp to the Amatole mountains (Acocks, 1953). Referring to the earlier extensive distribution of macchia, Rennie (1935) states, "Changing climatic conditions and the advance of the African (or Tropical) flora have led to the old temperate type on the mountains (of tropical Africa) as a series of relics". The extension of several Cape genera into the coastal districts of Pondoland and Natal and along the Drakensberg and the mountains of the Rhodesian border into East Africa, has frequently led to the assumption that the ancient migration of Cape flora to the north was essentially if not entirely along an eastern route.

Clearly the present day ecologist must distinguish between ancient relics and modern invasions when explaining the presence of macchia in the summer-rainfall area. While Clements (1934) was the first to explain the use of the "relict method" in ecology in detail, Lundegardh (1931) claims that, "The significance of relics is still very uncertain, they may in fact be outposts of an oncoming invasion". A knowledge of the habitat requirements is necessary for the intellegent application of the relic concept, a concept which becomes complicated when dealing with a genus such as *Passerina* which occurs under a 15″ rainfall near Windhoek (Rennie, 1935) and under a 79″ rainfall in the Natal Drakensberg (Killick, 1963).

Though no analysis has been made of the habitat conditions under which macchia is normally encountered in the summer-rainfall area, it is clearly correlated with high altitudes in most areas. Referring to the Cathedral Peak area of the Drakensberg, Killick (1963) emphasises the increasingly temperate character of the grassland with increase in altitude. The altitudinal zones in that area are also demarcated according to the importance of temperate species, e.g. Subalpine (6000′—9400′; *Passerina*, *Phillipia*, *Widdringtonia*), Alpine (9,400′—11,000′; *Erica*, *Helichrysum*). *Passerina montana* however occurs from 4,500′ to 10,000′ in that area, while Thoday (1924) reports it from 3000′ near King Williams Town.

Of the South African literature on the successional status of macchia, in various regions, the work of Story (1952) deserves special mention. In an attempt to unravel the successional and distributional patterns associated with *Cliffortia-Erica* macchia in the Amatole Mountains of the Eastern Cape, Story has written at length on the subject. His conclusions may be summarized as follows:

(*a*) The water requirements of macchia are greater than those of grassland and less than those of forest.
(*b*) Macchia ousts grassland from moist aspects.
(*c*) Fire destroys or effectively controls macchia and encourages grassland
(*d*) In the mid-altitudinal zones, grass is seral to macchia.
(*e*) Macchia is the climax at high altitudes (7300′) and seral to forest at mid-altitudes.
(*f*) Macchia does not occur in the drier lowlands (below 25″ rain).
(*g*) Indications are that *Passerina montana* cannot compete with the more robust *Cliffortia* and *Erica*.

Story's anatomical studies of the leaves of macchia vegetation support Thoday's (1921 and 1924) finding that these plants are well adapted to drought. The drought that these plants are subject to is usually of a physiological nature, due to non-availability of soil moisture resulting from the low temperatures which are common at the high altitudes at which macchia often occurs in the summer-rainfall area.

In view of the general assumption that members of the macchia communities have similar habitat requirements, the detailed investigations of Thoday (1924) are important. Working with six species of *Passerina* in the Cape, Thoday classified them all as gregarious pioneers. It was found that four of these were associated with specific different types of habitat, "defined largely in edaphic terms". "*Passerina montana* is distinctive morphologically, ecologically and geographically. It has the widest range of all, occurring from King Williams Town to the Northern Transvaal and near Umtali in Southern Rhodesia. Its occurrence in Southern Rhodesia raises wider questions of plant geography, for the nearest locality to the south is distant some four or five hundred miles".

DISCUSSION

Any serious consideration of the adaptation and distribution of communities with different climatic affinities must include an examination of the microclimate of the habitats concerned. In the case of temperate vegetation, the main features of the climate with which they are normally associated may be summarised as follows:

(*a*) a concentration of the reasonably low amount of precipitation in the winter, summers being almost or completely dry;

(*b*) warm to hot summers and very mild winters and

(*c*) a high percentage of the possible sunshine for the year, especially in summer. Such a climate characterises the southern Cape, with its macchia vegetation. Although the mean temperatures of the Hangklip area coincide with the Csb (warm temperate) climate as classified by the Köppen-Geiger system (1936), the dry winters distinguish this area from the Cape temperate climate. In order to explain the presence of communities dominated by temperate species with strong temperate affinities, the influence of physiographic factors on microclimate should be considered.

The author has adequately shown, from readings taken over a period of several years, that the mean temperature just above soil level is 6·7°F lower on the summit of a 2000′ mountain than at the base. In the same study it was shown that the mean temperatures on southern and eastern aspects were an average of 4·5°F lower than on northern and western aspects (Roberts, 1965). In the case of Hangklip the temperate communities are limited to the high-lying regions and the southern aspects at higher altitudes. It would thus appear that the temperate communities are associated with the cooler and moister conditions expected to result from the increase in altitude as well as from the oblique insolation on southern slopes, particularly during the winter.

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